Whiplash: The Numbers

- In 1928 Harold Crowe introduced the term “whiplash”
- Injury mechanism of sudden hyperextension followed by hyperflexion of the neck.
- Unfortunately the term “whiplash”, which was used originally to graphically describe the manner in which the head was suddenly moved, has become a commonly used diagnostic label.
- The biggest criticism associated with the labeling is the lack of information regarding the diagnosis, injury, prognosis or treatment.


Whiplash: Disease of the Century

- Whiplash is an acceleration-deceleration mechanism of energy transfer to the neck. This may result from rear end or side-impact MVA, but can also occur during diving or other mishaps. Impact may result in bony or soft-tissue injuries (whiplash injury), which in turn may lead to a variety of clinical manifestations (Whiplash Associated Disorders).


Whiplash: The Numbers

- “Disease of the century” with ever-increasing numbers of people diagnosed with WAD and seeking treatment.


Whiplash: The Numbers

- Motor vehicle collisions are the leading cause of death among Americans 1-34 years old and according to the U.S. Department of Transportation, the total societal cost of crashes exceeds $200 billion annually.
Whiplash: The Numbers

• With the ever-increasing number of patients with WAD and very little information available regarding the epidemiology, nothing written on diagnosis, prognosis and various interpretations of the treatments therapists often describe whiplash as one of the most challenging and frustrating conditions to treat.


• It is now accepted that approximately 1 in 4 or even as high as 1 in 3 patients following a MVC may develop pain lasting more than 2 years.

• It is also interesting to note that no management approach treating acute whiplash has substantially lessened the incidence of transition to chronicity of this disorder. Spitzer WD, Skovron ML, Salmi LR, et al. Scientific monograph of the Quebec Task Force on Whiplash-Associated Disorders: redefining "whiplash" and its management. Spine. Apr 15 1995;20(8 Suppl):1S-73S.

Whiplash: The Numbers

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• In fact recently the neck disability index (NDI) which was originally designed for mechanical neck pain was validated for use with the WAD patient. Refshauge KM, Bogduk N, Nicholas M. Responsiveness of pain and disability measures for chronic whiplash. Spine. Mar 1 2007;32(5):580-585.

• Several authors have described this as a pivotal part in the development of persistent pain in whiplash patients. Spitzer, Skovron et al. 1995; Gifford 1997; Bogduk 2003

• Numerous studies have shown the high incidence of missed injuries, including fractures on standard imaging studies such as x-ray, magnetic resonance imaging (MRI) and computerized tomography (CT).Spitzer, Skovron et al. 1995; Guramoorthy and Twomey 1998; Bogduk 2003; Bogduk 2006.

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• Clinical Issues
  - "On the topic of whiplash, there is no decent epidemiology, nothing written on diagnosis, and barely any treatment discussed works. Mobilization and manipulation seem to help for short periods of acute pain, but nothing helps for chronic pain." (Spitzer, Skovron et al. 1995)
  - It is notable that no management approach treating acute whiplash has substantially lessened the incidence of transition to chronicity of this disorder (Gennis, Miller et al. 1998; Provinciali, Baroni et al. 1996; Borchevinski, Kaasa et al. 1998; Soderlund, Olerud et al. 2000)

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• Patients
  - Middle aged people (35 - 55)
  - Especially women, due to the increased head and neck mass.
  - In general women also have a slower recovery time from whiplash injury. The incidence of whiplash injuries is not accurately known but figures ranging from 10% to 20 % of all motor vehicle accidents (MVAs) has been said to develop the "whiplash syndrome."
Whiplash: The Numbers

- Symptoms
  - A significant proportion of the patients have long-lasting symptoms, and some are disabled for long periods.
  - The most common symptoms are neck pain, neck stiffness, headache, shoulder pain, back pain, and difficulties with concentration and memory. Dizziness, buzzing in the ears, insomnia, depression, and anxiety also are reported.

- Patients have significant pain and dysfunction, yet imaging tests are unable to “find a cause” of the pain.
- This has unfortunately also caused patients with WAD to be viewed as malingerers, dishonest or even neurotic.

Summary

- Mc Nab originally described whiplash exclusively related to rear-end MVAs. A retrospective study of whiplash shows that only 46% of the subjects surveyed were involved in rear-end MVAs, contradicting the statements by Mc Nab. Mc Nab i. Acceleration Injuries of the Cervical Spine. The Journal of bone and joint surgery. American volume. Dec 1964;46-1797-1799.
- Extension injuries are by far the worst in terms of tissue damage (see whiplash pathology) and prognosis. Extension may reach an angle of 140 degrees, far above the normal range of 45 degrees; therefore, hyperextension of the neck is more prone to cause pathology Barnsley L, Lord S, Bogduk N. Whiplash injury. Pain. 1994;58:283-307.
- Bruising has been observed between the scapulas from the occiput in severe hyperextension injuries.

Liturigation

- “We are still living in the days where whiplash is a dirty term and wearing a collar is a clear sign of milking the system.” Gifford L, ed Topical issues in Pain 4. Falmouth: CNS Press; 2003.
- Many controlled studies have shown no direct link between chronicity and litigation/compensation claims (Mendelson 1995; Swartzman, Teasell et al. 1996)
- Patients involved in legal process report more pain and may be caused by increased stress of the legal process or patient's seeking compensation may be at the more severe end of the scale of injury.

Biomechanics

**Biomechanics**

- Forces in the hyperextension injury:
  - Extension
  - Posterior shear
  - Posterior compression
  - Anterior distraction
  - Traction
  - With any off-center hit: Torsion is added

- Deceleration injuries are significantly higher among those victims who were wearing seat belts
  - Tostelen, et al 1989

- A number of studies have shown that since the introduction of compulsory seat belt legislation, there has been a marked increase in the incidence of neck injuries among car occupants.*

**Whiplash: Biomechanics**

- Bi-phasic kinematic response:
  - 1st phase: S-curve with upper C-spine flexion and lower C-spine hyper-extension.
  - 2nd phase: All cervical levels extended – peak head extension


- “…a transient S shape of the spine resulted while the head remained upright during the initial phase of the impact.”

**Anthropometric studies**

- Impact of 15 miles/hour = acceleration force of 10G

- Deng & Goldsmith 1987a and b) with accelerometers showed:
  - Intra-discal pressure increases with flexion
  - Intra-discal pressure decreases with extension
  - Higher inter-vertebral disc pressure in the C-spine versus T-spine
  - Disc pressure highest in the C4-5 disc with F/E
  - Disc pressure highest in the C3-4 disc with lateral impact
  - Longus colli most at risk in E
  - Longus capitis most at risk lateral impact
  - There is a reaction time delay in muscle contraction, in response to sudden movement of the head and neck
  - The time required for the head to reach the peak excursion is shorter than the time required by the muscle to develop a reflex contraction
Viewing Whiplash

- "It's just a muscle strain"
  - Muscles
  - Ligaments
- It's a simple sprain and should be over quick
- Injury cannot occur in low speed collisions
- It's all about lawsuits

1. The name...

- Whiplash is an acceleration-deceleration mechanism of energy transfer to the neck. The impact may result in bony or soft-tissue injuries (whiplash injury), which in turn may lead to a variety of clinical manifestations (Whiplash-Associated Disorders)

2. Just a "muscle sprain"

- Facet joints – sprains and strains
- Long term spondylolisthesis
- Annular tear/bleeding
- Clefts into the cartilage endplate
- TMJ injuries*
- ALL tears*
- PLL tears*
- Ligamentum nuchae tears*
- Ligamentum flavum tears*
- Trigger Points (?)
- Bleeding - sub-arachnoid space
- Perlymph fistulas
  - Detectable via current clinical tests

2. Just a "muscle sprain"

- The injuries are REAL

Cadaver Studies

- Taylor and Twomey (Cadavers)
  - 94% disc injury
  - 74% facet joint injuries
  - 26% fractures
  - Average 2 segments injured
  - C5/6 and C6/7 were the most affected
  - (Most fractures not seen on X-ray)

2. Just a "muscle sprain"

- Intervertebral Disc
  - Rim lesions
  - Annular bruising
  - Avulsion
  - Endplate fracture
  - Bleeding
  - Associated with Anterior Longitudinal Ligament Tears
  - Inflammation
  - Most commonly affecting C5/6 and C6/7

* Detectable via current clinical tests

Images from Dr. Taylor
2. Just a “muscle sprain”

- Discogenic referral


- Zygaphophyseal Joints
  - Capsule avulsion
  - Cartilage damage
  - Sub-chondral bone fracture
  - Bleeding
  - Inflammation


- Ligaments
  - Anterior Longitudinal Ligament
  - Posterior Longitudinal Ligament
  - Ligamentum Flavum

- Muscle
  - Muscle tears
  - Bleeding
  - Anterior musculature
  - EMG changes in sternomastoid
  - Decreased activity of the longus coli


- Facet joint referral


- Facet joint referral


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  - Anterior Longitudinal Ligament
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  - Ligamentum Flavum

- Muscle
  - Muscle tears
  - Bleeding
  - Anterior musculature
  - EMG changes in sternomastoid
  - Decreased activity of the longus coli

3. It always happens at Wal-Mart

- Adreno-sensitive environment
  - Patients who damage tissue in adreno-sensitive environment (stressful) environment has a 7-8 x higher chance of developing chronic pain


Neck Pain in Demolition Derby Drivers


4. We cannot find it...

Diagnosis of whiplash

- X-Ray
  - High reported missed fractures and/or dislocations on X-ray
  - Estimated 33% missed fractures on X-ray
  - Missed disc injuries

- MRI/CT Scan
  - Better than X-ray
  - Many “false-positives”
  - Not “standard of care”
5. A “shock” to the system...

**Documented injury of neural tissues in WAD**

- Subdural haematoma — Ommaya et al 1969
- Intracranial bleeding — Monroe et al 1993
- Cranial nerve — Bring 2000; Hildingsson et al 1989
- Temporary 6th nerve palsy — Yemakoti et al 1995
- C2 contusions — Pfeil 1982
- Cervical radiculopathies...when a herniated disc impinges on the root.” — Jonsson et al 1994; Schnarnowski et al 1993
- Longus colli damage with sympathetic nerve damage — Mekhan 1970
- Obstruction of epidural veins – compressing the dorsal root ganglion (‘forming a cuff’)
- Proliferation of fibrous tissue inside and around neural tissue — Jansen et al 1989

5. A “shock” to the system...

- Subjects with chronic WAD demonstrated significantly less ROM and higher VAS scores with the **Upper Limb Tension Tests** than the asymptomatic subjects.

5. A “shock” to the system...

- Slump: “Knee extension and ankle dorsiflexion during the slump test produced significant increase in the intensity of cervical symptoms in the whiplash group. The whiplash group also showed a greater limitation in knee extension ROM.”

5. A “shock” to the system...

**Increased sensitivity to:**
- Mechanical Pressure
- Temperature
- Immune events
- Stress/ Anxiety
- Movement

The Dorsal Root Ganglion...

- Non-myelinated
- Likely significant source of persistent pain in WAD
- Extremely adrenosensitive
- Extremely mechanosensitive
- Extreme latency – may not “fire” for 2-3 weeks after injury
Dorsal Root Ganglion Damage in WAD...

Whiplash: Neural Injury
- Well reported: Injury to brain, spinal cord and nerve roots
- Scarring and tethering
- Damage to the vascular structures of the brain
- Sympathetic symptoms may also be an epiphenomenon that arises in response to the stress of the injury.
  - Some studies (McNab 1964) have shown, associated with longus colli injuries, damage to the sympathetic nerves in the cranial region

5. A “shock” to the system...

Whiplash: Headache

Bogduk and others showed that several structures, when stimulated, have also been shown to cause headaches (Bogduk 2004; Bogduk 2004):
- Z-joints
- Atlanto-occipital joints and ligaments
- Ligaments of the cervical spine
- Annulus of the IVD
- Periosteum of the VB
- Cervical muscles

Whiplash: Headaches
- Up to 33% of headaches result from the cervical spine
- Very common following MVA
- Upper cervical spine (C2/3)
- Typical:
  - Occipital
  - Orbital
  - Occipito-frontal
  - Frontal
  - Sub-occipital
  - Temporal
5. A “shock” to the system...

Central sensitivity means the primary lesion/dysfunction is located in the neurones of the spinal cord, brain stem and/or cerebral hemipheres.

Adapted from Gifford 1998

6. The Whiplash Brain…(Physical)

Acute Subdural Hematoma

White = Blood
Gray = Brain
Note loss of G-W junction and massive shift

6. The Whiplash Brain…

- Areas consistently activated by acute pain not altered in WAD group
  - Neuronal processing of acute pain different from chronic pain

6. The Whiplash Brain…

- PREMOTOR/ MOTOR CORTEX
  organize and prepare movements

- CINGULATE CORTEX
  concentration, focusing

- PREFRONTAL CORTEX
  problem solving, memory

- AMYGDALA
  fear, fear conditioning, addiction

- SENSORY CORTEX
  sensory discrimination

- HIPPOCAMPUS
  memory, spatial recognition, fear conditioning

- SPINAL CORD
  gating from the periphery

6. The Whiplash Brain…

- It will get better, right?
  - Thirty percent of patients reporting symptoms after 3 months of the accident, still have ongoing symptoms and functional impairment at 2 years after the injury.

7. It will get better, right?

- Mobilization and manipulation seem to help for short periods of acute pain, but nothing helps for chronic pain.
- About one third (25-49%) of people with acute WAD progress to chronic WAD.

8. Defending the whiplash patient

- Sympathetic Nervous System
  - Adrenaline
  - Redirects blood flow
  - Increase nerve sensitivity
  - Persistent barrage into the CNS

References:
**Sympathetic Sprouting and basket weaving**

Causes and consequences of sympathetic basket formation in dorsal root ganglia

Matt S. Ramer, Stephen W. N. Thompson, Stephen B. McMahon

**SNS is efferent & contribute to pain by:**

- Dorsal root ganglion – non-myelinated
- Action potential develop due to adrenaline
- Nerve fires….both ways

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**8. Defending the whiplash patient**

- **Motor**
  - Decrease stabilizers
  - Deep neck flexors
  - Ischemia of the Postural muscles
  - Muscle imbalances

---

**Trapezius Pain in WAD**

- In a recent study, the microcirculation in the trapezius muscles of twenty five “whiplash” patients (Post-injury period ranging from 3 – 18 months) was measured using Doppler flowmetry.
  - Decreased blood flow
  - Ischemia


---

**Remember: Anthropometric studies**

- Deng & Goldsmith 1987a and b) with accelerometers showed:
  - There is a reaction time delay in muscle contraction, in response to sudden movement of the head and neck
  - The time required for the head to reach the peak excursion is shorter than the time required by the muscle to develop a reflex contraction

There is growing evidence that trigger points (TP’s) are in fact an epi-phenomenon, and rather than being the originator of the pain, they are more a consequence of the damaged tissue. (Cohen 1996, Wall 1993)
8. Defending the whiplash patient: Cortisol

Adrenaline
- (Epinephrine)
- Adrenal medulla

Cortisol
- (Hydrocortisone)
- Adrenal cortex

Cortisol
- Tissues
  - Sore
  - Tired
  - Sensitive
  - Fatigued

Cortisol
- Brain
  - Memory
  - Sleep
  - Concentration
  - Blood pressure
  - Reproduction
  - Other

Cortisol
- Immune
  - Cytokine signaling
    - IL-1
    - IL-6
    - TNF-α
  - Increased nerve sensitivity
  - Persistent inflammation
  - Brain plasticity

Tissues

Brain

BRAIN
Subjective Evaluation

Subjective
1. Kind of Disorder
2. History
3. Site of the Symptoms
4. Behavior of the Symptoms
5. Special Questions
   - Additional Medical Tests

1. Kind of Disorder
   - Why do people come to PT after car accidents?

2. History
   - Find out as much as you can about the accident...

2. History
   - Symptoms at and after the MVC

2. History
   - Going to the ED
2. History

• Treatment since the MVA

3. Area of Symptoms

Nerve Root

Disc
4. Behavior of Symptoms

- ? better
- ? worse
Whiplash

5. Special Questions

NDI

Medical Tests

CAT SCAN

Screening the acute and sub-acute whiplash patient

- The priority list is designed to ensure you screen for the important issues and limit the potential for injury, as well as screening a patient to be a candidate for PT. Finally, the tests should also be able to strengthen or negate your hypothesis regarding the primary diagnosis based on your subjective examination (Maitland 1986; Maitland, Hengeveld et al. 2001; Maitland, Hengeveld et al. 2005)
- A priority list for whiplash may include (in sequence):
  1. Observation
  2. Cranial nerve screening
  3. Cord compression screen
  4. Vertebra/artery screening
  5. Neurological screening
  6. Active ROM
  7. Palpation

Screening the acute and sub-acute whiplash patient

Symptoms that are suspect of VA involvement:
- Vertigo
- Nystagmus
- Horner’s syndrome
- Adduction of the ipsi-lateral eye
- Contra-lateral limb and trunk pain and temperature sensation loss
- Ipsilateral soft palate deviation
- Dysphagia
- Dysphonia
- Nausea/Vomiting
- Dizziness – cardinal symptom present in ALL VBI injuries

VBI

Property of ISPI – not to be copied without permission
Yellow Flags

- **Emotions:**
  - Fear of increased pain
  - Depression
  - Irritability
  - Anxiety
  - Stress

- **Behaviors:**
  - Extended rest
  - Poor compliance
  - Extreme pain ratings
  - Excessive reliance on aids/devices
  - Sleep disturbance
  - High intake of alcohol or medication
  - Smokers

- **Family:**
  - Overprotective
  - Punitive responses

- **Work:**
  - Manual work
  - Work history
  - Belief that work is harmful
  - Unhappy at work
  - Low educational background
  - Working shifts
  - Negative previous experiences at work with LBP

- **Compensation:**
  - Lack of financial incentive to return to work
  - Extended time off work
  - Number of claims
  - Previous history of LBP
Yellow Flags

- Diagnosis and Rx:
  - Sanctioning disability
  - Conflicting diagnosis
  - Language
  - Passive Treatments
  - Number of health care providers
  - “Techno-fix”
  - Lack of satisfaction
  - “If it hurts – don’t do it”
- Selling treatment in numbers

Where are we at?

- Tissues do get injured; they heal and likely a minor source for persistent pain in whiplash

- Up to 40% of patients with whiplash associated disorders suffer persistent pain and disability 2 years out

- Emerging research is implicating a “waking” of the nervous system, which explains persistent, high-level and spreading pain

Testing a Sensitive N-System


Overview of the clinical examination of patients with suspected central sensitization:

Clinical tests

1. Assessment of pressure pain thresholds at sites remote from the symptomatic site
2. Assessment of sensitivity to touch during manual palpation at sites remote from the symptomatic site
3. Assessment of sensitivity to vibration at sites remote from the symptomatic site
4. Assessment of sensitivity to heat at sites remote from the symptomatic site
5. Assessment of sensitivity to cold at sites remote from the symptomatic site
6. Assessment of pressure pain thresholds during and following exercise
7. Assessment of joint end feel
8. Brachial plexus provocation test

Testing the Whiplash Patient

Red Flags!!!!!

Danger!

Stop

Listen to your gut

Run

Testing a Sensitive N-System


Clinical

- Pressure pain thresholds
- Hot/cold sensitivity testing
- Nerve palpation
- Neurodynamic testing
Whiplash Treatment: best evidence

Review of the Literature

- Originally, Crowe 1927 considered in general “the less the treatment, the better it is.”
- Gray and Abott 1953 advised bed rest during the first 24 – 72 hours and sedation as part of the medical approach and concluded that “constant use of a cervical collar resulted in atrophy and worsening of symptoms.”
- Numerous early studies recommended the IMMEDIATE start of therapeutic traction, with/without the application of heat.
- The first studies on exercise started showing up in the 60’s where authors such as Knot(1961) recommended traction and isometric exercises, followed by relaxation exercises.

Review of the Literature

- The first major study was published by Janes and Hooshmand (1965), who investigated 10,000 whiplash patients between 1956 and 1963. They showed:
  - 80% of their patients improved in the first year
  - Recommended immobilization in a Peterson brace for 6 weeks
  - Muscle relaxers and hot moist heat
  - Steroid injections in the trigger-points
  - Patients immobilized for 6 weeks, had significantly less pain after removal of the collar 6 weeks after the injury.

Quebec Task Force:

Whiplash-Associated Disorders

“On the topic of whiplash, there is no decent epidemiology, nothing written on diagnosis, and barely any treatment discussed works. Mobilization and manipulation seem to help for short periods of acute pain, but nothing helps for chronic pain.”
- Dr. Nikolai Bogduk


Study Layout

Methods:
- Studies/Literature reviewed relating to whiplash disorders, i.e., Medline.
- Literature subjected to a two-stage screening process.
- Inclusion criteria:
  - 1980 - 1993
  - English/French
  - Acceleration-deceleration injury to neck from MVA
  - Exclusion criteria: Grade 0 and Grade IV not included
  - Additional notes up until July 1994 was added.

Process:
- 2 Year period
- 16 paired task force members.
- Accepted study: Both relevant and meritorious.

Results:
- Collected articles: 10382
- Eligible articles for screening: 1204
- Studies for independent review: 294
- Relevant & meritorious: 62
- (21% of the 294 articles)
Results

Collars: Commonly prescribed
May delay recovery: increased pain, decrease R.O.M.
Soft collars do not adequately immobilize the spine*

Rest: Commonly prescribed for the first few days.
Should be limited to less than 4 days*
Detrimental to recovery from WAD

Cervical pillows: No studies found.

Manipulation: Single manipulation reduced asymmetry; lasted less than 48 hours.
Manipulation vs. mobilization: Same effect in decreasing pain and increasing R.O.M.
Long-term manipulation is not justified.*

Results

Exercise: No independent effects of exercise has been evaluated
Evidence suggests exercise as part of a multi-modal intervention may be beneficial (short and long-term)

Posture: No studies.
Spray and stretch: No studies.
TENS: No accepted studies
Fentanyl: No studies
Ultrasound: No studies
Laser, Diathermy, Heat: No independent studies.
Ice, Massage: Were part of the combination of passive modalities in different studies.
Surgery: No studies on surgery or nerve blocks

Results

Injections: - Epidural, intrathecal: No studies.
- Intra-articular steroid: "not justified in the management of WAD"

Pharmacology:
Analgesics
NSAI D's: Shown to be effective with the use of physical modalities
Muscle relaxants: No studies.
Psychosocial: No studies.
Acupuncture: No studies.

Task Force Conclusions

NSAI D's and analgesics, short term manipulation and mobilization by trained persons, and active exercises are useful in grade II, and III WAD, but prolonged use of soft collars, rest, or inactivity probably prolongs disability in WAD.

"Interventions that promote activity such as mobilization, manipulation, and exercises in combination with analgesics or NSAI D's are effective on a time-limited basis."

"The key message to the WAD patient is that pain is not harmful, is usually short-lived and is controllable."


Update on Evidence
Physical Education, especially early on very important:

- Educational videos (Brison, Hartling et al. 2005; Oliveira, Gevirtz et al. 2006; Hurwitz, Carragee et al. 2009)
- Education helpful early on (Lundmark and Persson 2006)

Since the QTF...

**A quick review of the highest forms of evidence (systematic reviews and high-quality randomized controlled trials) published in the last 10 years:**

- **Education**, especially early on very important:
  - Educational videos (Brison, Hartling et al. 2005; Oliveira, Gevirtz et al. 2006; Hurwitz, Carragee et al. 2009)
  - Education helpful early on (Lundmark and Persson 2006)

Since the QTF...Limited Evidence

- **Usual care** (Hurwitz, Carragee et al. 2009)
- **Physical modalities** (Hurwitz, Carragee et al. 2009)
- **Conflicting if stabilization exercises** help (Drescher, Hardy et al. 2008)
- **The current literature is of poor methodological quality and is insufficiently homogeneous** to allow the pooling of results. Therefore, clearly effective treatments are not supported at this time for the treatment of acute, sub-acute or chronic symptoms of whiplash-associated disorders. **Cochrane 2007; (Verhagen, Scholten-Peeters et al. 2007)**
- **Soft collar** not helpful (Lundmark and Persson 2006)
- An evidence-based educational **pamphlet** provided to patients at discharge from the emergency department is no more effective than usual care for patients with grade 1 or 2 whiplash-associated disorders(Reitan, Rowe et al. 2005)
- Further research is required to test the validity of this sub-group observation and to test the effect of the intervention in the long term. (Ut, Sterling et al. 2007)
- **Immobilization, "act-as-usual," and mobilization** had similar effects regarding reduction of pain, disability, and work capability 1 year after a whiplash injury. (Kongsted, Qerama et al. 2007)

Since the QTF...

**A systematic review was conducted to evaluate the strength of evidence associated with various WAD therapies.**

- Based on current evidence, **activation-based therapy** is recommended for the treatment of **acute WAD**: However, additional research is required to determine the relative effectiveness of various exercise-mobilization programs. (Teasell, McClure et al. 2010)
- Although some evidence was identified to support the use of interdisciplinary interventions and manipulation, the evidence was not strong for any of the evaluated treatments. There is a clear need for further research to evaluate interventions aimed at treating patients with **subacute WAD** because there are currently no interventions satisfactorily supported by the research literature. (Teasell, McClure et al. 2010)
- Based on the available research, **exercise programs** were the most effective noninvasive treatment for patients with chronic WAD, although many questions remain regarding the relative effectiveness of various exercise regimens. (Teasell, McClure et al. 2010)

Since the QTF...

**Movement – exercise, manual therapy and “act as usual”**

- **Mobilization** (Hurwitz, Carragee et al. 2009)
- **Exercise** (Hurwitz, Carragee et al. 2009)
- Moderate evidence postural exercise for decreasing pain and time off work (Drescher, Hardy et al. 2008)
- In the short-term exercise and advice is slightly more effective than advice alone for people with persisting pain and disability following whiplash. Exercise is more effective for subjects with higher baseline pain and disability (Gevirtz, Maher et al. 2007)
- For patients exposed to whiplash trauma in a motor vehicle collision, an active involvement and intervention were both less costly and more effective than a standard intervention (Rosenetti, Sefenadis et al. 2006)
- Supervised training was significantly more favorable than home training, with a more rapid improvement in self-efficacy, fear of movement/injury and pain disability at three months. Further, supervised training significantly reduced the frequency of analgesic consumption. The improvements were partly maintained at nine months. (Bunkers, Lindt et al. 2008)
- Active movement is helpful (Peeters, Verhagen et al. 2007)

Since the QTF...

**Physical therapy** is effective in the treatment of whiplash injury, especially in order to get the patients fit to go back to their previous employment. (Avinirfeyz, Cook et al. 2009)

- **Intensive therapy** in late whiplash syndrome can achieve improvement of different outcome measures including working ability in two-thirds of patients, more effective in women, persisting beyond 6 months in half. Additional cognitive-behavioral therapy was the most effective treatment modality. Classification of evidence: This interventional study provides Class III evidence that CBT used as an adjunct to infiltration, medication, or physiotherapy increases improvement rates in persons with late whiplash syndrome. (Pato, Di Stefano et al. 2010)
- The rehabilitation program (drug adaptation, graded activity exercise, relaxation therapies, and behavioral therapy) showed moderate to large mid-term improvements in important health dimensions, medication reduction and working capacity. Further controlled studies are required to quantify and attribute these improvements more precisely. (Angst, Françoise et al. 2010)

Since the QTF...

**Neurobiology education:**

- Results showed a significant decrease in kinesiophobia (Tampa Scale for Kinesiophobia), the passive coping strategy of resting (Pain Coping Inventory), self-rated disability (Neck Disability Index), and photophobia (WAD Symptom List). At the same time, significantly increased pain pressure thresholds and improved pain-free movement performance (visual analog scale on Neck Extension Test and Brachial Plexus Provocation Test) were established. Although the current results need to be verified in a randomized, controlled trial, they suggest that education about the physiology of pain is able to increase pain thresholds and improve pain behavior and pain-free movement performance in patients with chronic WAD. (Van Oosterwijck, Nijs et al. 2011)
Consider This Whiplash Study...

- **Physicians:**
  - 71% involved in MVA
  - 31% recall acute symptoms
  - Short lived symptoms (days – weeks)
  - 9% had symptoms > 1 year
  - Maximum one week off work

- **Non-physicians:**
  - 60% involved in MVA
  - 46% recall acute symptoms
  - Symptoms lasted approx. 6 months
  - 32% had symptoms > 1 year
  - Common to take > 6 months off


Education

- Why educate patients in PAIN about anatomy and biomechanics?
- Why not just teach them more about….PAIN?

Image: Clinical Journal of Genius 2012

Google: Whiplash

Education Models for WAD

Why Educate?

- There are high levels of fear related to movement in WAD patients
- Fear impacts movement
- Fear impacts pain and function
- Education has shown the ability to reduce fear
**Current Models**

- Most education programs used in orthopedic patient populations utilized anatomical and biomechanical models for addressing pain (Maier-Riehle and Harter 2001; Butler and Moseley 2003; Moseley 2003; Moseley 2004; Brox, Storheim et al. 2008) which:
  - **Limited efficacy** (Koes, van Tulder et al. 1994; Maier-Riehle and Harter 2001; Butler and Moseley 2003; Waddell 2004; Brox, Storheim et al. 2008) and
  - **Even increase patient fears, anxiety and stress, thus negatively impact their outcomes** (Nachemson 1992; Hirsch and Liebert 1998; Maier-Riehle and Harter 2001; Poiraudeau, Rannou et al. 2006)

**Education**

A Psycho-Educational Video Used in the Emergency Department Provides Effective Treatment for Whiplash Injuries

Ali Oliveira, PhD,* Richard Gevirtz, PhD,* and David Hubbard, MD†


**Therapeutic Neuroscience Education**

Emerging research shows that explaining to patients their pain experience from a biological and physiological perspective of how the nervous system/brain's processes pain allow patients to move better, exercise better, think different about pain, push further into pain, etc.


**Efficacy Neuroscience Education**

Conclusions: For chronic MSK pain disorders, there is compelling evidence that an educational strategy addressing neurophysiology and neurobiology of pain can have a positive effect on pain, disability, catastrophization, and physical performance.

Too many numbers?

- 34 year-old female
- 4.5 years of pain
- Started as LBP, then spread to her buttocks and now into both legs
- Pain would flare up with stress at work
- First child 2.5 years ago – “horrible” labor, delivery and pain
- Now constant LBP
- Not able to return to work
- Now severe spasms in both legs
- CT, MRI and X-Ray WNL
- Meds: High doses of pain killers and narcotics

Segmental Spinal Stabilization Exercises:
- 1 week practice
- 5 minutes each waking hour

1 – to – 1 pain physiology education

Key message of this study...

- Every PT clinic should have an fMRI...

4 Questions a Patient Wants Answered

1. “Doc, what’s wrong with me?”
2. “Doc, how long’s it going to take to get better?”
3. “Doc, is there anything I can do to help myself?”
4. “Doc, is there anything you can do to help me?”

Louis Gifford, forward Therapeutic Neuroscience Education: Teaching Patients About Pain.
"Doc, what's wrong with me?"

"Tissues get injured, Tissues HEAL!!!!!

The Nervous System


Your Alarm System: Normal

Alarm System
Specific to your situation

Nerve Sensors and Sensitive Nerves

Waking up the alarm system
• Motion Detector Lights
• Car Sensors

Waking the Neighbors

The Police...

Louw, A; Your Nerves Are Having Back Surgery. 2012
How do you know this?

Why did my nerves stay so sensitive?

How do we calm it down?

“Doc, how long’s it going to take to get better?”
A Few Therapeutic Possibilities...

- Education – “know pain, know gain”
- Exercise – “motion is lotion” / “sore but safe”
- Medication

Tissue Recovery

Pain Recovery

“Doc, is there anything I can do to help myself?”
**Altering Beliefs**

- Decreased cortical activation

**SO WHAT?**

- Making Lions into Lion Cubs!!!

**Endogenous Mechanisms**

Know pain = Know gain

**A Few Therapeutic Possibilities...**

- Neuroscience Education
- Tactile/Skin
- Movement/Blood Flow
- Body Parts/Body Space
- Reduce Threat

**Pacing/Graded Exposure**

**“Doc, is there anything you can do to help me?”**
Neuroscience Education

Pain neurophysiology education improves cognitions, pain thresholds, and movement performance in people with chronic whiplash: A pilot study.


1. Your Accident…Move On

Your Car Accident
Woke Up Your Nerves
Neuroscience Education for Whiplash Patients

Continuous Nervous System

Your Alarm System

Specific to your situation
Why did your alarm system stay extra sensitive

1. Space
2. Movement
3. Blood

Can You Remember what nerves need?

Calming Nerves Down

With all the irritation, the nerve is still in "alarm mode." With the healing, medication and gentle movement opening the space, attention should now focus on calming the nerves down.
Your Car Accident Experience

Calming Nerves Down

1. Knowledge

Calming Nerves Down

2. Blood and Oxygen

Calming Nerves Down

3. Medicine…but…

Calming Nerves Down

• Wet brains and dry brains

Recovery

- Sore but safe
- No freaking out
- Go over floor slips
- Delayed recovery
- Motion is lotion
1. Neuroscience Education

- Smudging

2. Left/Right

Left/right discrimination is the accuracy and speed of identifying whether a picture or body part is a right or left.

2. Left/Right

- Magazines
- Make flash cards
  - Internet images
  - Take photos
- Make a PowerPoint

- nogroup.com
  - Flashcards
  - Online
  - Smartphone publications
2. Left/Right

- Cards – Internet Images

3. Imagery

- Imagine extremity (see it visually)
  - Static
  - Dynamic
  - Doing tasks
- Giving the brain map exercise without moving the extra sensitive extremity

3. Imagery - Example

- Been used for years in Sport
- Very important potential role in acute/severe pain

3. Imagery

- Ask patient for top 10 tasks needed to be performed with painful extremity
- Find 10 such activities/images on the Internet
- Draw card; imagine static hand in that position
- Imagine moving hand to similar position
- Imagine performing the task

4. Sensory Discrimination

- Why discrimination and not integration?

Tactile discrimination, but not tactile stimulation alone, reduces chronic limb pain

G. Lorimer Moseley 1,2,3, Nadia M. Ziobicki 1,2, Karija Wüth\footnote{1. University of Newcastle, 2. Swedish Institute for Sports Research, 3. Hunter Medical Research Institute}

4. Sensory Discrimination

- Why discrimination and not integration?

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4. Sensory Discrimination

5. Graphesthesia training

Now...

- The patient is likely ready for THERAPY...

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